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ABSTRACT

This report examines the overlap between student test results on the Iowa Test of Basic Skills (ITBS) and the Washington Assessment of Student Learning (WASL). The two tests were compared and contrasted in terms of content and measurement philosophy, and analyses studied the statistical relationship between the ITBS and the WASL. The ITBS assesses a student's level of achievement within the four broad domains of reading, mathematics, language, and vocabulary. The WASL assesses a student's level of achievement within the four broad domains of reading, mathematics, writing, and listening. The statistical analyses, which considered whether the mathematics and reading subtests of both tests would form two distinct factors or a single underlying factor, were based on individual student-level data for 45,601 students who were given the ITBS in grade 3 in 1999 and grade 4 in 2000. The ITBS and WASL are similar yet different in content and measurement philosophy. In general, students who score high on one test will score high on the other. But the scores on the ITBS and the WASL are not perfectly related, and in some cases, are only weakly related. Results also suggest that the reading and mathematics subtests are more clearly distinguishable on the WASL than on the ITBS. It seems likely that a factor analysis on the individual items would yield a much cleaner distinction between reading and mathematics on both tests. (SLD)

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Washington School Research Center

Technical Report #2 – September 2001

The Relationships Between the Iowa Test of Basic Skills and the Washington Assessment of Student Learning in the State of Washington

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The Relationships Between the Iowa Test of Basic Skills and the Washington Assessment of Student Learning in the State of Washington

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A Technical Report For
The Washington School Research Center

Washington School Research Center

Forward

Since 1993 educational reform efforts in the state of Washington have focused on three broad areas—the identification of Essential Academic Learning Requirements (EALRs), new student assessments of those requirements, and accountability. Extensive work in this second area has resulted in the Washington Assessment of Student Learning (WASL) given in the fourth, seventh, and tenth grades. These assessments are closely tied to the EALRs, and the results of these tests have become increasingly important to educators, policymakers and the public. At the same time, schools are also required to administer the Iowa Test of Basic Skills (ITBS) in third and sixth grades. Given the very different nature of the WASL and ITBS, questions have arisen regarding the relationship of student performance on the two assessments and the degree to which the assessments are complementary.

In Technical Report # 2 from the Washington School Research Center, professors Joireman and Abbott present a series of analyses that focus on these questions. Their primary sample is based on over 45,000 students who completed the third grade ITBS in 1999 and then completed the fourth grade WASL in 2000. Identical analyses are run on a second sample of over 16,000 students who completed the fourth grade WASL in 1998 and then completed the sixth grade ITBS two years later in 2000. "Will students who score high on the ITBS score high on the WASL, and vice versa? . . . the general answer is yes. . . . Students who score high on the ITBS Reading, Math, and Language Tests are likely to score high on the WASL Reading, Math and Writing tests. However, the sizes of these correlations are not so high as to conclude that the ITBS and WASL provide an identical assessment of student learning."

Going beyond these general findings, Joireman and Abbott examine the different subtests within the ITBS and WASL, which "provides further support for the claim that the two tests assess similar, but not identical, abilities." They find: "In sum, the ITBS and WASL are most similar in the major domains of Math and Reading, and are less strongly related in the remaining domains [listening, writing, language], and in terms of the subtests within each major domain."

Finally, a statistical procedure called factor analysis is used to determine "whether reading and math on the ITBS and WASL are distinct or related learning domains." The results suggest that reading and math on the WASL are more distinguishable than on the ITBS.

These analyses provide important information for Washington educators. The moderate correlations suggest that each test covers learning domains not covered in the other, thus being complementary. The moderate correlations also suggest that there is significant overlap between the instruments and that students (and therefore schools) who do well on one of the tests will tend to also do well on the other test. The combination of the two tests provides a more comprehensive picture of student achievement than does either of the tests individually. The results also suggest that

success on the WASL Math assessment is less dependent on reading and language skills than is success on the ITBS Math assessment.

The data analyses in this report focus only on the elementary grades and do not provide the final answers to questions about the compatibility of the WASL and ITBS for learning assessments. On-going yearly analysis of the tests scores is important and should be extended to the upper grades. Nonetheless, the information contained in this report suggests that while the elementary level WASL and ITBS measure some of the same skills, each provides unique information on student achievement.

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Introduction

Educators in the State of Washington currently administer both the Iowa Test of Basic Skills (ITBS) and the Washington Assessment of Student Learning (WASL). On the surface, the two tests appear to be similar, but not identical. These apparent similarities and differences raise an important question, namely, what is the relationship between the ITBS and the WASL? If the correlation between the ITBS and WASL is extremely high, administering both may involve unnecessary developmental and administrative costs. On the other hand, if the correlation between the two tests is only moderate, this would raise an additional question, namely, is one test better than the other, or should the ITBS and WASL be viewed as complementary tests? The present technical report attempts to shed initial light on these questions by examining the overlap between the ITBS and WASL. In this report, we compare and contrast the ITBS and WASL, both in terms of content and underlying measurement philosophy, and report a series of data analyses aimed at assessing the statistical relationship between the ITBS and WASL. This report helps to extend past research sponsored by the Washington State Office of the Superintendent of Public Instruction (OSPI) on the relationship between the WASL and the Comprehensive Test of Basic Skills (CTBS) (Taylor, 1998).

Overview of the ITBS and WASL

The ITBS assesses a student's level of achievement within four broad domains including reading, math, language, and vocabulary. As we explain in more detail below, each of the first three domains is composed of a number of subtests. The ITBS is a norm-referenced test, in that it assesses a student's level of achievement relative to other students. All items on the ITBS have a multiple choice response format, and all tests are timed.

The WASL assesses a student's level of achievement within four broad domains including reading, math, writing, and listening. As with the ITBS, the first three major domains are composed of a number of subtests. The WASL is a criterion-referenced test, in that it assesses a student's level of achievement relative to a pre-specified set of "essential academic learning requirements." The WASL contains both multiple choice and open-ended response formats, and all tests are untimed.

These brief descriptions suggest, on the surface at least, that the ITBS and WASL are similar, yet different, in both content and measurement philosophy. To facilitate a more detailed comparison of the two tests, we present a brief description of the major domains and subtests on the ITBS and WASL in Tables 1 and 2, respectively. In Table 3, we present a theoretical comparison of the two tests.[1]

[1] For more information on administration of the WASL and ITBS in Washington, visit www.k12.wa.us/assessment/WASLintro.asp. For more technical information on the WASL, visit www.k12.wa.us/assessment/qawasl.asp. For more technical information on the ITBS, visit www.riverpub.com/products/group/itbs.htm.

Data Analysis Strategy

As just noted, the intent of this report is to examine the relationship between the ITBS and WASL. We proceed in two ways. First, we examine the correlations between the major domains and subtests on the ITBS and WASL. Second, we examine the extent to which reading and math can be treated as similar vs. distinct constructs on the ITBS and WASL, respectively. To address this second question, we (a) examine the correlations between the various domains and subtests within the WASL and ITBS, respectively; (b) use factor analysis to examine whether reading and math subtests represent the similar or distinct underlying dimensions on the WASL and ITBS, respectively; and (c) factor analyze all of the reading and math subtests on the WASL and ITBS as a set.

Our first goal addresses whether the ITBS and WASL can be treated as redundant vs. complementary tests. Very small correlations between theoretically-related domains (see Table 3) would call into question the validity of at least one of the tests. Very large correlations, on the other hand, might call into question the necessity of administering both tests. Moderate correlations would suggest that the ITBS and WASL are similar, but not identical tests. Because past studies have validated both the ITBS and WASL, it is unlikely that the ITBS and WASL will show near-zero correlations. Still, because no studies have examined the relationship between these two tests, it remains to be determined whether the ITBS and WASL represent similar vs. identical (redundant) tests. It should be noted that even if the ITBS and WASL are highly redundant, such results would not, by themselves, provide a basis for choosing between the tests.

Our second goal addresses whether reading and math on the ITBS and WASL are distinct or related. Because many math items require the student to solve real-world problems, it would not be surprising to find that reading and math are to some extent correlated. However, if reading and math are too highly correlated—and, as a result, form a unified underlying factor—this may call into question the validity of the math test.

Method

Sample Characteristics

The analyses presented in this report are based on individual student-level data obtained from the Washington State Office of the Superintendent of Public Instruction (OSPI). The sample included 45,601 students who were given the ITBS in Grade 3 in 1999 and the WASL in Grade 4 in 2000. Students were matched using district identification numbers. Due to the fact that not all students in the original OSPI data sets could be perfectly matched across grades, these students represent a sample of the population tested. The current sample included 22,287 females, 23,294 males, and 20 students who did not identify their sex. The ethnic composition of the sample was as follows: Alaskan Native/American Indian (2.1%), Asian Pacific Islander (7.9%), African American (5.4%), Hispanic (7.9%), White (75.8%), Multi-Racial (0.3%), and Unidentified (0.5%).

Results

Primary Sample - Major Domains

Correlations Among the Major Domains on the ITBS

The top left portion of Table 4 displays the correlations between the major domains on the ITBS. On the ITBS, Reading, Math and Language show the strongest inter-correlations (.73 to .77), with the Vocabulary test showing somewhat weaker correlations with Math (.67) and Language (.68). Because the Vocabulary test is part of the larger Reading test, the high correlation between Vocabulary and Reading (.94) is not surprising.

Correlations Among the Major Domains on the WASL

The bottom right-hand portion of Table 4 shows the correlations between the major domains on the WASL. The correlation between WASL-Reading and WASL-Math is identical to the correlation between ITBS-Reading and ITBS-Math (.73). However, the WASL Writing test (which partly reflects language ability) shows weaker correlations with WASL Reading and Math (average = .63) than ITBS Language shows with ITBS Reading and Math (average = .76). This suggests that, in comparison with the ITBS Language test, the WASL Writing test is somewhat less redundant with the other major WASL domains. The WASL Listening test shows the lowest correlation with any of the remaining WASL tests (average = .51). In sum, these initial analyses suggest that, in comparison to the ITBS, the WASL subtests may assess more distinct content and/or assess a wider range of student achievement.

Correlations Between the Major Domains on the ITBS and WASL

The bottom left portion of Table 4 shows the correlations between the ITBS and WASL major domains. Several results are worth noting. First, ITBS Reading, Math, and Language, show their highest correlations with WASL Reading (.72), Math (.77), and Writing (.66), as would be expected on the basis of their theoretical overlap (see Table 3). Second, it is interesting to note that the correlation between WASL-Reading and ITBS-Math (.66) is identical to the correlation between ITBS-Reading and WASL-Math (.66). Third, based on the relatively low correlations, it appears that the WASL Listening test has no equivalent on the ITBS. Finally, it would appear that the ITBS-Vocabulary is most closely associated with WASL-Reading (.66).

These analyses suggest that while three of the major domains on the ITBS (reading, math, and language) overlap to some extent with three of the major domains on the WASL (reading, math, and writing), the overlap is not so high as to suggest that the ITBS and WASL are identical tests. Indeed, the highest correlation (ITBS and WASL Math = .77) indicates that, at best, the major domains on the two tests share only 59% of the variance (i.e., the correlation coefficient squared). By traditional standards, this is

a relatively high correlation. However, considering that the two tests are designed to measure the same domain, this overlap is not as high as one might expect.

Primary Sample - Subtests

Correlations between Subtests on ITBS

Table 5 presents the correlations between the various subtests on the ITBS. As can be seen, the two reading subtests (Comprehension and Vocabulary) showed a relatively strong correlation (.76). Correlations between the three math subtests were also moderate to high, ranging from .64 to .78. Finally, the two reading subtests and the three math subtests showed weak to relatively strong correlations, ranging from .47 to .70 (average = .61). As might be expected, the reading subtests tended to show stronger correlations with the Problem Solving/Interpretation math subtest (average = .69) which requires a student to read and understand a problem; in contrast, the reading subtests were less strongly associated with the Pure Computation math subtest (average = .54).

Correlations between Subtests on WASL

Table 6 presents the correlations between the various subtests on the WASL. We begin by examining the correlations within each major domain. As can be seen in the top left portion of Table 6, the correlations between the four reading subtests ranged from .62 to .72. Correlations between the Math Content subtests (numbered 7 to 11 in the Table) ranged from .48 to .62, while correlations between the Math Process subtests (numbered 12 to 15 in the Table) ranged from .52 to .60. Finally, the correlation between the Writing Content and Mechanics subtests was .67. Correlations between the WASL-Reading and WASL-Math subtests were moderate, ranging from .45 to .60 (average = .51). These results were generally in line with those reported in Taylor's (1998) analysis of the 1998 4th Grade WASL Scores, although the correlations in the present study tended to be slightly higher than those reported by Taylor. It is also interesting to note that the WASL Reading and Math tests were less strongly related (average = .51) than were the ITBS Reading and Math subtests (average = .61).

ITBS and WASL Reading Subtests

To further examine the relationship between the ITBS and WASL, we next computed correlations between the various subtests on the two tests (see Table 7). We begin by considering the correlations between the various reading subtests. As can be seen in the top left portion of the table, the correlations between the ITBS and WASL reading subtests are moderate and relatively homogeneous (ranging from .51 to .57), with the WASL subtests showing approximately equal relationships with the ITBS Comprehension subtest (average = .54) and ITBS Vocabulary subtest (average = .53). Combined with the earlier findings, this indicates that while the major reading domains share approximately 52% of the variance, the overlap between the ITBS and WASL reading subtests averages only 29%.

To further assess the relationship between the ITBS and WASL Reading subtests, we next conducted an exploratory factor analysis on the six reading subtests to evaluate whether a single underlying factor could account for the subtests. An examination of the eigenvalues (first four eigenvalues = 3.94, 0.73, 0.45, 0.35) and scree plot both suggested the presence of one factor, which explained 65.6% of the variance. Taken in combination with the simple correlations reported earlier in this section, these results suggest that the various reading subtests on the ITBS and WASL, while not identical, do seem to tap a similar underlying factor.

ITBS and WASL Math Subtests

We next turn to the correlations between the various ITBS and WASL Math subtests, as shown in Table 7. Several patterns seem worth noting. First, most of the correlations are low to moderate (.38 to .61; average = .51, or 26% of the variance). Second, in comparison with the Reading subtest correlations, which range from .51 to .56, the Math subtest correlations show a larger range (.38 to .61). Third, compared with the remaining Math subtests, two WASL subtests (Geometric Sense and Probability/Statistics) and one ITBS subtest (Computation) show notably weaker correlations with the subtests on the opposing inventory, suggesting that the WASL and ITBS Math tests may be distinct in these respects.

To follow up these simple correlations, we next conducted an exploratory factor analysis on all of the math subtests to evaluate whether a single underlying factor could explain the subtests. An examination of the eigenvalues (first four eigenvalues = 6.81, 0.84, 0.60, 0.56) and scree plot both suggested the presence of one factor, which explained 56.8% of the variance. These results suggest that the various math subtests on the ITBS and WASL, while not identical, appear to tap a similar underlying factor.

ITBS Language and WASL Writing Subtests

Beyond reading and math, it appeared on the surface the ITBS Language and WASL Writing tests should also overlap. However, most of the correlations are low to moderate (.43 to .58; average = .50, or 25% of the variance). An examination of the correlations in Table 7 also reveals that each of the ITBS Language subtests overlaps to a greater extent with the WASL Mechanics subtest (average correlation = .53) than with the WASL Style/Organization subtest (average correlation = .43).

To follow up these simple correlations, we next conducted an exploratory factor analysis on the WASL Writing and ITBS Language subtests to evaluate whether a single underlying factor could explain the subtests. An examination of the eigenvalues (first four eigenvalues = 3.82, 0.76, 0.42, 0.38) and scree plot both suggested the presence of one factor, which explained 63.6% of the variance. These results suggest that the various Language and Writing subtests on the ITBS and WASL, while not identical, appear to tap a similar underlying factor.

ITBS Vocabulary and WASL Listening

While not a primary focus of this report, it is worth briefly commenting on the ITBS Vocabulary and WASL Listening subtests. As can be seen in Table 7, the ITBS Vocabulary test (which serves as both a subtest of reading, and a stand alone test) is most closely associated with the WASL Reading subtests. In a similar fashion, the WASL Listening score is most closely associated with the ITBS Reading score. These correlations, however, are not extremely high (ranging from .49 to .56). The WASL Listening score, in particular, appears to be a relatively unique subtest, as its correlation with the remaining ITBS subtests is relatively small (.33 to .49).

Factor Analyses of Reading and Math

As noted in the introduction, a second goal of the present report is to evaluate whether reading and math on the ITBS and WASL represent distinct or related constructs. To examine this question, we first factor analyzed the Reading and Math subtests on the WASL and ITBS separately. We subsequently factor analyzed all of the Reading and Math tests on the ITBS and WASL as a set.

An exploratory factor analysis of the Reading and Math subtests on the WASL suggested the presence of either one or two factors (first four eigenvalues = 7.51, 0.97, 0.56, 0.53). One factor explained 57.8% of variance. Two factors explained 65.3%. Because the second eigenvalue was close to one, we extracted two factors. We subsequently used an oblique rotation, assuming that the two factors would, to some extent, be correlated. The pattern matrix loadings are shown in Table 8. As can be seen, the two factors are most appropriately labeled High Math Ability and Low Reading Ability. While the Math and Reading subtests were clearly separated in this analysis, it is worth noting that the two factors still showed a relatively high correlation (-.73).

An exploratory factor analysis of the Reading and Math subtests on the ITBS suggested the presence of one factor (first four eigenvalues = 3.60, 0.63, 0.31, 0.24). This one factor explained 72% of variance.

As a follow-up to the two factor analyses just reported, we conducted one final factor analysis using the Math and Reading subtests on both the ITBS and WASL. An examination of both the scree plot and eigenvalues suggested the presence of three factors (first five eigenvalues = 9.66, 1.13, 1.06, 0.60, 0.58). The three factors explained 65.8% of variance. Accordingly, we extracted three factors using an oblique rotation. The resulting pattern matrix loadings and correlations between factors are shown in Table 9. As can be seen, the three factors are clearly interpreted as WASL Math Ability, WASL Reading Ability, and ITBS Low Reading/Math Ability combined. These results, combined with the two factor analyses reported directly above suggest that reading and math are more clearly distinguishable on the WASL in comparison with the ITBS.

Replication Sample

Replication: 4th Grade WASL (1998) with 6th Grade ITBS (2000)

To examine the stability of our results, we conducted an identical set of analyses for a different group of 16,331 students who completed the 4th Grade WASL in 1998 and the 6th Grade ITBS in 2000. The overall pattern of the results in the replication group was generally consistent with the results reported in the main body of the current technical report. Nevertheless, two exceptions to this general pattern should be noted, both focusing on factor analyses in which we incorporated both reading and math subtests. First, in the replication group, the first factor analysis (WASL Reading and WASL Math subtests) suggested the presence of only one factor, whereas in our primary group, results suggested the presence of two factors (Reading and Math, respectively). An exploratory two factor solution in the replication group did, however, clearly separate WASL Reading and WASL Math, consistent with our primary results. Second, in the replication group, the third factor analysis (WASL and ITBS Reading and Math subtests) suggested the presence of two (rather than three) factors. These factors could be interpreted as WASL/ITBS Math (except for ITBS Problem Solving), and WASL/ITBS Reading (with ITBS Problem Solving showing its highest loading on this factor). An exploratory three-factor solution resulted in three clearly distinguishable factors including WASL Math, WASL/ITBS Reading, and ITBS Math. In sum, results from the replication group provide weaker support for the claim that Reading and Math are more clearly distinguishable on the WASL, in comparison to the ITBS.

Discussion

The purpose of the present technical report was two-fold. First, we sought to examine the relationship between ITBS and WASL scores administered to students in the State of Washington. Second, we sought to examine whether the math and reading subtests on the ITBS and WASL would form two distinct factors, or a single underlying factor. In what follows, we briefly address each of these questions, and then consider some of the practical implications of our findings.

What is the Relationship between Scores on the ITBS and Scores on the WASL?

As noted in the introduction, the ITBS and WASL are similar yet different in both content and measurement philosophy. The two tests are similar in that they both contain math and reading tests, and they both include a measure of language use (ITBS)/writing (WASL). The two tests differ, however, in the remaining tests, and in their underlying measurement philosophy (norm- vs. criterion-referenced). These similarities and differences beg the obvious question, namely, what is the relationship between the ITBS and the WASL? Will students who score high on the ITBS score high on the WASL, and vice versa? As we explain below, the general answer is yes. However, scores on the ITBS and WASL are not perfectly related and in some cases are even weakly related, suggesting in the end that the two tests are not identical.

Our results suggest that the two tests are most similar in the domains of math and reading, with respective correlations of .77 and.72. As expected, the ITBS Language and WASL Writing were also correlated, but to a lesser extent (.66). The remaining tests (Vocabulary on the ITBS and Listening on the WASL) showed weaker correlations across the ITBS and WASL, suggesting that these tests are the most unique stand-alone tests on the ITBS and WASL, respectively.

As a set, the correlations just noted suggest that the ITBS and WASL assess similar learning domains. Restated, students who score high on the ITBS Reading, Math, and Language tests are likely to score high on the WASL Reading, Math, and Writing tests. However, the sizes of these correlations are not so high as to conclude that the ITBS and WASL provide an identical assessment of student learning. For example, the strongest correlation (i.e., .77 between ITBS and WASL Math tests) indicates that only 60% of the variance in WASL math scores is explained by ITBS math scores, while the next strongest correlation (i.e., .72 between ITBS and WASL Reading) indicates that only about 52% of the variance in WASL reading scores on one test is explained by scores on the ITBS.[2] The overlap between the two tests drops even further in the case of language/writing skills, where the correlation (i.e., .66 between ITBS Language and WASL Writing) indicates that only about 44% of the variance in WASL Writing scores can be explained by ITBS Language scores. And, as noted, the correlations involving ITBS Vocabulary (as a stand-alone test) and WASL Listening are fairly low, suggesting that the two tests are relatively unique in these domains.

An examination of the correlations between the various ITBS and WASL subtests within a given domain provides further support for the claim that the two tests assess similar, but not identical, abilities. For example, correlations between the ITBS and WASL math subtests range from .38 and .61; correlations between the ITBS and WASL reading subtests range from .51 and .57; and correlations between the ITBS language subtests and the WASL subtests range from .34 to .52. In sum, the ITBS and WASL are most similar in the major domains of math and reading, and are less strongly related in the remaining domains, and in terms of the subtests within each major domain.

Do Reading and Math Form a Unified Underlying Factor on the ITBS and WASL?

Our second goal was to examine whether reading and math on the ITBS and WASL are distinct or related learning domains. Our results tentatively suggest that reading and math subtests are more clearly distinguishable on the WASL than on the ITBS. The clearest support for this claim comes from the series of three factor analyses: (a) Reading and Math on the WASL; (b) Reading and Math on the ITBS; (c) Reading and Math on the ITBS and WASL. The first analysis indicated that ITBS reading and math subtests formed a single underlying factor. The second analysis suggested that WASL Reading and Math form distinct factors. The third analysis revealed a clear separation between WASL Reading and WASL Math, with ITBS Reading and ITBS Math forming a third factor. As a set, these analyses suggest that reading and math subtests are more

[2] Because the ITBS was administered first, it is appropriate to treat the ITBS as a predictor of the WASL scores.

closely related on the ITBS than they are on the WASL. This conclusion should, however, be treated as preliminary for several reasons. First, our replication sample failed to confirm this pattern. Second, it is important to recognize that we factor analyzed the reading and math subtests, rather than the individual items. It seems likely that a factor analysis on the individual items would yield a much cleaner distinction between Reading and Math on both the WASL and the ITBS. Future research will be needed to assess the extent to which reading and math abilities are related on the two tests, and whether this is appropriate.

Limitations

Before closing, it is appropriate to note several limitations of the present study. First, because the ITBS and WASL were not administered in the same year, there was a one-year gap between the ITBS and WASL in our primary study, and a two-year gap in our replication study. During this time, it is likely that at least some students in this study experienced life events that impacted their follow-up scores. While it is impossible for us to know the frequency or nature of such events, in theory, such life events would likely have the effect of reducing the strength of the correlation between scores on the ITBS and WASL. If true, the correlations in the present study would represent an underestimation of the true strength of the relationship between the ITBS and WASL.

A second limitation of the present study centers on the nature of the scores used for analysis. In the present report, we analyzed subtests, rather than individual items. In our primary study, factor analyses of the reading and math subtests suggested that reading and math form separate factors on the WASL, but a single factor on the ITBS. It is possible that a factor analysis of the individual Math and Reading items would more clearly distinguish between Reading and Math on the ITBS. As such, it is most appropriate to treat the present factor analytic findings as exploratory, and in need of future verification.

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Table 1

Description of Major Domains and Subtests on the ITBS.

Major Domain Subtest(s)	Description
Reading	
Comprehension	Assesses students' understanding of various styles of written communication (e.g., fiction, non-fiction, poetry, biographies). Includes literal and non-literal interpretations.
Vocabulary	Assesses students' ability to relate a target word presented in a given context to a list of four other similar words. Assesses general vocabulary (rather than "technical" vocabulary).
Math	
Concepts & Estimation	Understanding of math concepts (e.g., number systems, fundamental operations, basic measurement) and ability to use estimation (rather than actual computation). Minimal computation required.
Problem Solving & Interpretation	Ability to solve novel problems using math concepts and operations typically learned one year prior to test. Ability to interpret data presented in graphical and tabular form.
Computation	Direct measure of computational skill using three number systems (whole, fraction, decimal) and four operations (addition, subtraction, multiplication, division). Not confounded with concept/estimation skills.
Language	
Spelling	Spelling
Capitalization	Capitalization
Punctuation	Punctuation
Usage & Expression	Use of grammar, skill in expressing ideas in a clear/logical manner.
Vocabulary	(See above). Serves as a stand-alone domain, and a reading subtest.

Table 2

Description of Major Domains and Subtests on the WASL

Major Domain / Subtest(s)	Description
Reading	
Fiction – content	Understanding of main ideas of a passage of fiction.
Fiction – analysis	Ability to analyze, interpret, critique a passage of fiction.
Non-fiction – content	Understanding of main ideas of a passage of non-fiction.
Non-fiction – analysis	Ability to analyze, interpret, critique a passage of non-fiction.
Math	
Content Strands	
Number Sense	Understanding of number systems, operations, computation, estimation.
Measurement	Understanding measurement systems and attributes, selection and use of appropriate measurement procedures, ability to estimate measurements.
Geometric Sense	Understanding of shapes and lines, construction and transformation of geometric figures, location of objects in space.
Probability & Statistics	Understanding of probabilities, methods of data collection, data analysis and reporting, generalizing from sample data.
Algebraic Sense	Understanding patterns, sequences, symbols, notation, and equations.
Process Strands	
Problem Solving	Investigating situations, defining problems, constructing solutions.
Logical Reasoning	Ability to analyze information, evaluating reasoning, make predictions, draw conclusions based on analysis.
Communicates Understanding	Ability to collect, read, understand, and present mathematical information.
Making Connections	Link various concepts and procedures, use, create, and evaluate, equivalent mathematical representations, and apply mathematical thinking to other disciplines and real-world situations.
Writing	
Content	Content, organization, and style of a student's writing sample.
Mechanics	Spelling, grammar, punctuation, capitalization of writing sample.
Listening	Uses listening skills to gain understanding of main ideas, details, meaning; checks understanding by paraphrasing, clarifying, questions.

Table 3

Theoretical Overlap in Major Domains and Subtests on the WASL and ITBS

WASL	ITBS
Reading Fiction – content Fiction – analysis Non-fiction – content Non-fiction – analysis	Reading Comprehension and Vocabulary
Math *Content Strands* Number Sense Measurement Geometric Sense Probability & Statistics Algebraic Sense	Math Concepts and Estimation; Computation Concepts and Estimation
Process Strands Problem Solving Logical Reasoning Communicates Understanding Making Connections	Problem Solving and Interpretation
Writing Content Mechanics	Language Usage and Expression; Vocabulary Spelling; Capitalization; Punctuation; Usage and Expression
Listening	*No equivalent on ITBS*
Writing (content) and Reading	Vocabulary

Table 4

Correlations Among and Between Major Domains on the ITBS and WASL

	ITBS				WASL			
ITBS	Reading	Math	Language	Vocabulary	Reading	Math	Writing	Listening
Reading								
Math	.73							
Language	.75	.77						
Vocabulary	.94	.67	.68					
WASL								
Reading	.72	.66	.64	.66				
Math	.66	.77	.66	.61	.73			
Writing	.59	.58	.66	.54	.63	.63		
Listening	.53	.48	.43	.49	.59	.54	.41	

Note. N's for correlations with ITBS Language (26,964 to 27, 437). N's for all remaining correlations (42,064 to 44,291). All correlations significant at $p < .01$ (two-tailed).

Table 5

Correlations Among Major Domains and Subtests on the ITBS

	Reading			Math				Language				
	1	2	3	4	5	6	7	8	9	10	11	12
1. Reading (Overall)												
2. Comprehension	.94											
3. Vocabulary	.94	.76										
4. Math (Overall)	.73	.71	.67									
5. Concepts/Estimation	.69	.66	.63	.92								
6. Problem Solving /Interpretation	.73	.70	.68	.92	.78							
7. Computation	.52	.51	.47	.83	.68	.64						
8. Language (Overall)	.75	.72	.68	.77	.71	.71	.65					
9. Usage	.76	.72	.70	.70	.65	.68	.53	.85				
10. Spelling	.65	.62	.61	.64	.59	.58	.55	.83	.65			
11. Capitalization	.60	.58	.54	.64	.59	.58	.57	.88	.62	.66		
12. Punctuation	.56	.55	.50	.65	.60	.58	.57	.86	.61	.62	.70	

Note. All N's > 27,400. All correlations significant at $p < .01$ (two-tailed)

Table 6

Correlations Among Major Domains and Subtests on the WASL

	Reading					Math										Writing		
							Content					Process						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. **Reading (Overall)**																		
2. Ideas Fiction	.79																	
3. Analysis Fiction	.85	.72																
4. Ideas N-Fiction	.70	.66	.62															
5. Analysis N-Fiction	.85	.69	.69	.68														
6. Math (Overall)	.73	.56	.61	.55	.67													
7. Number Sense	.54	.48	.52	.48	.55	.75												
8. Measurement	.56	.51	.53	.51	.57	.77	.58											
9. Geometric Sense	.49	.51	.51	.49	.55	.70	.52	.55										
10. Probability and Statistics	.48	.51	.50	.48	.54	.63	.48	.50	.48									
11. Algebraic Sense	.57	.53	.55	.52	.60	.79	.60	.62	.58	.52								
12. Problem Solving	.60	.46	.53	.47	.57	.80	.59	.59	.52	.47	.61							
13. Logical Reasoning	.56	.49	.53	.48	.56	.77	.56	.60	.53	.49	.61	.60						
14. Communicates Understanding	.54	.46	.50	.45	.54	.73	.53	.54	.48	.46	.57	.58	.54					
15. Making Connections	.52	.46	.49	.46	.54	.74	.57	.60	.54	.47	.61	.59	.57	.52				
16. Writing (Overall)	.63	.49	.53	.48	.58	.63	.47	.48	.43	.43	.50	.52	.49	.48	.45			
17. Content, Style, Organization	.58	.60	.61	.56	.64	.57	.50	.50	.49	.51	.53	.50	.50	.49	.47	.90		
18. Mechanics	.55	.53	.53	.51	.58	.56	.47	.48	.47	.45	.51	.48	.48	.46	.46	.88	.67	
19. **Listening**	.59	.48	.51	.45	.52	.54	.40	.42	.36	.35	.44	.45	.42	.40	.39	.41	.39	.34

Note. All N's > 43,600. All correlations significant at $p < .01$ (two-tailed).

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Table 7

Correlations Between Major Domains and Subtests on the ITBS and WASL

	ITBS												
	Reading			Math				Language					Vocab
WASL	Overall	Comp.	Vocab	Overall	ConEst	PS/Intp.	Comp.	Overall	Usage	Spell	Cap.	Punc.	Vocab
Reading													
Overall	**.72**	.69	.66	.66	.61	.65	.49	.64	.63	.55	.53	.50	.66
Ideas Fiction	.55	.52	.52	.48	.44	.47	.36	.47	.47	.41	.38	.35	.52
Analysis Fiction	.58	.56	.54	.52	.49	.52	.39	.52	.51	.44	.42	.40	.54
Ideas N-Fiction	.55	.52	.51	.50	.47	.49	.38	.48	.47	.43	.40	.36	.51
Analysis N-Fiction	.60	.57	.56	.58	.54	.56	.45	.57	.53	.49	.47	.45	.56
Math													
Overall	.66	.63	.61	**.77**	.72	.73	.61	.66	.62	.54	.55	.55	.61
Content													
Number Sense	.50	.48	.46	.59	.55	.56	.48	.51	.47	.42	.43	.42	.46
Measurement	.52	.49	.49	.63	.59	.60	.50	.52	.49	.44	.43	.42	.49
Geometric Sense	.43	.41	.40	.50	.47	.48	.40	.44	.41	.36	.37	.37	.40
Probability and Statistics	.41	.39	.38	.45	.42	.43	.38	.41	.39	.35	.35	.34	.38
Algebraic Sense	.51	.48	.47	.62	.57	.58	.50	.52	.49	.43	.44	.44	.47
Process													
Problem Solving	.56	.53	.52	.63	.58	.61	.49	.55	.52	.44	.46	.45	.52
Logical Reasoning	.50	.48	.46	.59	.55	.57	.47	.51	.48	.42	.43	.42	.46
Communicates Understanding	.49	.47	.45	.55	.51	.52	.43	.50	.47	.40	.41	.41	.45
Making Connections	.47	.45	.44	.60	.56	.56	.48	.49	.45	.40	.41	.41	.44
Writing													
Overall	.59	.57	.54	.58	.53	.53	.50	**.66**	.57	.60	.56	.53	.54
Content, Style, Organization	.50	.48	.46	.48	.44	.45	.42	.54	.48	.48	.46	.43	.46
Mechanics	.53	.51	.49	.53	.49	.48	.47	.61	.52	.58	.52	.49	.49
Listening													
Overall	.53	.51	.49	.48	.45	.49	.34	.43	.45	.34	.35	.33	.49

Note. All N's > 27,400. All correlations significant at $p < .01$ (two-tailed).

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Table 8

Pattern Matrix Loadings for WASL Reading and Math Subtests: Two-Factor Solution

WASL Subtest	Factor: High Math Ability	Factor: Low Reading Ability
Problem Solving	.87	.08
Making Connections	.86	.09
Logical Reasoning	.78	-.02
Number Sense	.77	-.01
Measurement	.77	-.05
Algebraic Sense	.76	-.09
Communicates Understanding	.76	.01
Geometric Sense	.60	-.18
Probability and Statistics	.39	-.36
Fiction Content	-.08	-.95
Non-fiction Content	-.02	-.86
Fiction Analysis	.06	-.82
Non-fiction Analysis	.21	-.71

Note. Correlation between High Math Ability and Low Reading Ability Factors = -.73.

Table 9

Pattern Matrix Loadings for ITBS and WASL Reading and Math Subtests: Three Factor Solution

Subtest	Factor		
	WASL High Math Ability	WASL High Reading Ability	ITBS Low Reading and Math Ability
WASL - Making Connections	.81	-.07	-.03
WASL - Algebraic Sense	.77	.06	-.01
WASL - Geometric Sense	.73	.12	.14
WASL - Logical Reasoning	.72	.04	-.05
WASL - Measurement	.72	.02	-.11
WASL - Number Sense	.71	.01	-.08
WASL - Problem Solving	.68	.02	-.16
WASL - Communicates Understanding	.66	.07	-.05
WASL - Probability and Statistics	.58	.26	.17
WASL - Fiction-Content	.08	.81	-.01
WASL - Fiction-Analysis	.15	.71	-.07
WASL - Non-Fiction Content	.09	.71	-.09
WASL - Non-Fiction Analysis	.29	.59	-.08
ITBS - Comprehension	-.04	.41	-.70
ITBS - Vocabulary	-.08	.43	-.68
ITBS - Concepts/Estimate	.39	-.03	-.64
ITBS - Problem Solving/Interpretation	.35	.06	-.63
ITBS - Computation	.45	-.17	-.55

Note. Correlations between factors: WASL Math and Reading (.59); WASL Math and ITBS Low Math and Reading Ability (-.52); WASL Reading and ITBS Low Math and Reading Ability (-.34).